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## THE BIOLOGIC ASPECTS OF HAY FEVER AND ASTHMA<sup>1</sup>

THE selection of hay fever and bronchial asthma for the exposition of biologic relationships may appear curious, and yet few of the many ills to which we may fall victims are as clearly dependent upon pure biological reactions. The group of so-called allergic diseases in which the biologic factors are quite similar comprise such apparently unrelated conditions as asthma, hay fever, urticaria or the hives, eczema, some cases of migraine or sick headache, of colitis and certain other less clearly defined conditions. For the sake of brevity we will devote our attention only to the first two states which are the most clearly understood.

Hay fever scarcely requires description, since the condition is so widespread that nearly every one has had some acquaintance with it. It has been fairly accurately estimated that 1 per cent. of the entire population of the United States suffers from one form or another of hay fever.

At certain times of the year, particularly the spring or early fall, some persons will experience attacks of sneezing with profuse watery discharge from the nose, irritation of the eyes and of the throat which will persist in varying intensity for weeks or months. Usually these attacks recur at the same time each year, sometimes several times during the year and occasionally at quite irregular intervals. Bronchial asthma, like hay fever, usually occurs in periodic attacks, sometimes seasonal in their distribution, separated by intervals of complete or nearly complete freedom from symptoms. The victim would describe asthma as a condition in which, beginning usually with a fit of coughing, he will rapidly become choked up, finding it most difficult to breathe either in or out. Breathing becomes labored, noisy, wheezy, the respirations become rapid, developing in a relatively short time to a state of actual air hunger which persists for a variable time. Relief comes gradually with the onset of an easier cough in which more phlegm is raised and the breathing gradually returns to normal. In the acute stages the cough is non-productive. As the patient has it, if he could only raise the mucus he would feel better, and when at last he does do so he rapidly improves.

<sup>1</sup> Invitation address before the Virginia Academy of Science, at the College of William and Mary, Williamsburg, Va., May 4, 1928.

Not infrequently asthma and hay fever occur in the same individual. Severe hay fever is always in danger of developing into asthma.

Formerly asthma was considered a purely nervous disorder. There has perhaps been a tendency among physicians in the past, when they could not discover the reason for periodic attacks of illness in otherwise normal persons, to pass the blame on to the victim, designating the malady as nervous and unconsciously insinuating thereby that the asthmatic could control his attacks if he would. But that day has passed.

Our search for the underlying cause of these allergic diseases began with the opening of the twentieth century. The original workers, whose primary interest was a study of the mechanism by which the human body becomes immune to certain diseases, were not at all interested in asthma or hay fever. It was not until 1910 that the suggestion was made that the knowledge gained from a study of the mechanism of immunity might be successfully applied toward an understanding of the cause and relief of the allergic diseases.

At the beginning of this century some new and curious observations were being made. Guinea-pigs were being inoculated through the skin with various proteins such as egg white, horse serum, dead typhoid bacilli, the protein or rice grains and the like. These injections scarcely made the animals ill. But, curiously, if after an interval of ten days or two weeks the same amount of the same protein or even a smaller amount was again inoculated into the same animal the latter became acutely ill and died within a matter of minutes. Strange to say, the symptoms in these pigs, who died of what came to be termed anaphylactic shock, were remarkably similar to the symptoms of asthma as we see it in humans.

Something curious had happened in these animals between the first and second inoculation of the same material which on the first injection had appeared quite harmless and on the second had killed almost immediately. This curious animal experiment has been the basis for all our subsequent study of immunology and many theories have been suggested to explain the phenomenon of anaphylaxis as I have just described it. Almost as soon as one research student proposes a theory which appears to satisfactorily explain all the known facts of anaphylaxis some other worker will present new experimental evidence which the proposed theory does not satisfactorily explain. New facts are constantly accumulating and the older theories have not answered the questions which they have raised.

Just now we are in the stage of accumulation of data. Sometime a theory will be proposed which will withstand the attacks of the most critical. How-

ever, a tremendous volume of knowledge has been built up on the basis of the older theories, and our understanding of asthma and hay fever is based nearly entirely on them. Thus, even though as originally proposed they may eventually fall completely into the discard, they have been responsible for the relief of suffering of millions of humanity.

At the risk of exposing myself to the charge of unwarranted dogmatism I shall briefly present to you one of the theories of anaphylaxis which explains lucidly the biologic causes for hay fever and asthma. I will ask you to realize that there are facts which the theory does not explain and that eventually it will necessarily undergo many modifications.

Unicellular animals, such as the ameba, paramecium or the typhoid bacillus, derive their food supply from their immediate environment. Carbohydrate is used for fuel, to keep the engine going, as it were, and the amino-acids, those relatively simple nitrogenous units which when linked together form proteins, are assimilated by the living cell for the purpose of growth and reproduction and protoplasmic repair. A single living cell in a medium where there is an abundance of appropriate amino-acids and of carbohydrate or energy producing substance will grow and reproduce. But not infrequently the available amino-acids in the immediate environment are chemically bound together into more complex substances, such as peptones, proteoses or even actual proteins. Every protein consists of a combination of amino-acids. Each different kind of protein represents a different combination of the amino-acids. There are not more than twenty amino-acids to be found in native proteins and yet these may be combined in so many different ways as to produce an almost limitless number of distinct proteins very much as the twenty-six letters of our alphabet may be so combined as to produce an endless variety of words. Different proteins may contain different types of amino-acids or they may contain the same amino-acids in varying proportions, or again these units may be combined into the protein molecule in different chemical groupings or locations. The protein of colon bacillus differs from the protein of ameba in the quality, relative proportion and intramolecular placement of the constituent amino-acids. In order that the ameba may build the amino-acids of colon bacillus into its own structure it must first digest the colon bacillus, breaking apart the constituent amino-acids, discarding any that it does not itself possess or require and utilizing the remainder. In the case of ameba the disruption probably occurs within the digestion vacuole, after which the amino-acids are absorbed and built into the protoplasmic structure of the living cell.

According to the theory it is a fundamental biologic law that whenever a living cell comes into contact with a foreign protein it will elaborate an enzyme or ferment which will digest and destroy the foreign protein so that its constituent amino-acids will be available for the nutrition of the living cell.

Living cells appear to possess proteolytic ferments which will readily digest a large variety of proteins. These ferments may be likened to keys which unlock the combinations in which the proteins are bound together. In every protein the combination is different, but there are master keys which will unlock many combinations. On the other hand, the living cell sometimes finds in its environment a protein which the general proteolytic ferment or master key will not unlock. Stimulated by the presence of this foreign protein the cell will then build a new key which will fit the combination. The cell elaborates an enzyme or ferment, specific for that particular foreign protein which will digest that protein and none other. Time is required for this enzyme production. There is evidence that ten days or two weeks are necessary before the living cell will produce the new enzyme in large amounts. After it has once learned to elaborate the enzyme it continues to retain this ability and the enzyme will be poured out whenever the cell is again stimulated by contact with the specific foreign protein.

So much for unicellular organisms. The same biologic principles appear to hold when large numbers of cells are aggregated together, as in the guinea-pig or human being. In complex organisms such as these groups of cells take on special functions. The individual cells become specialists. The cells in the gastro-intestinal tract secrete the general proteolytic ferments or the master keys. This no longer becomes a necessary function of the tissue cells within the body, whose environment is always essentially the same, that is, the blood and lymph, in which foreign proteins do not normally appear, for they have already been broken down in the process of normal digestion.

But if you will inject a foreign protein such as egg albumin or egg white into a guinea-pig, thus sidestepping normal gastro-intestinal digestion, the foreign protein appears in the blood and lymph, thus changing the immediate environment of the tissue cells.

According to the theory, the body cells so stimulated by the presence of a foreign protein and lacking in their high specialization any considerable degree of general proteolytic ferment immediately set to work to manufacture a specific enzyme which will digest and destroy this one specific protein, egg albumin. This is the change that has taken place in the guinea-

pig, following the first injection of egg white. Now, why does the pig die immediately after the second injection?

There is evidence that as protein is being digested, as the constituent amino-acids are being chopped off one by one, we may say, or in terms of organic chemistry, as the uncombined or free valences are being greatly multiplied, a stage is reached in which the remaining portion of the molecule becomes extremely poisonous. We might say that the unsatisfied valences of the partially digested protein molecule become so numerous and in view of their number so strong that they will tear off amino-acids from the living cells in the neighborhood. This is pure hypothesis.

At any rate, proteins may be partially digested in the test-tube and divided into two parts, one poisonous and the other non-poisonous, the former of which, when injected for the first time into guinea-pigs, will produce typical anaphylactic shock with its asthmatic symptoms followed by rapid death.

Following the first introduction of egg white the body cells manufacture the specific enzyme slowly, the foreign protein is digested slowly, and too little poison is liberated at any one time for symptoms to become manifest. Upon the second injection the cells immediately pour out large amounts of enzyme or the enzyme may be already present in large amounts in the blood and lymph with the result that destruction of the foreign protein takes place rapidly and such a great volume of protein poison is liberated almost at once that the serious symptoms of anaphylactic shock rapidly ensue.

Anaphylaxis does not occur in normal enteric digestion, because this is really taking place outside of the body, in the stomach and intestines, and while the protein poison is probably formed at one stage in the digestion, it is still further broken down into its harmless constituent amino-acids before absorption through the mucous membrane of the intestines takes place. This is the theory of anaphylaxis that has been developed by Dr. Victor C. Vaughan.

And now we come to asthma as we see it in humans.

We speak of an animal which has been rendered sensitive to the repeated introduction of a foreign protein as being sensitized. Diseases in which the phenomenon described plays a part are termed sensitization diseases. The curious phenomenon which occurs on the second injection or reinjection of an experimental animal is termed anaphylaxis, derived from the Greek and meaning *without protection*, just as prophylaxis means *for protection, favoring protection*. The analogous human diseases, hay fever, asthma, some cases of hives, eczema, migraine, colitis and a few other conditions, are termed allergic diseases. Allergy means literally *altered energy* or ac-

tivity or altered reactivity. This is rather a happy appellation, for it indicates an alteration that has occurred in the tissues of the body without attempting to explain it more precisely in terms of any theory which would be sure to require subsequent change.

There are several points of divergence in the similarity between experimental anaphylaxis and clinical allergy, as it is seen in humans. Some of these divergences are so definite that it is still a question whether the experimental disease and the natural disease are dependent upon identical processes. But all our progress in treatment has been made on the basis of an assumed relationship or identity and it is not within the province of this presentation to enter into the minutiae of this and similar unsettled questions.

Some persons will develop attacks of sneezing or asthma after riding behind horses. Others develop these symptoms after inhaling the pollen of certain plants, particularly weeds and grasses and sometimes trees. Among still others the symptoms become manifest after the eating of certain foods, such as clams, strawberries, chocolate, eggs or wheat.

The purified proteins from horse hair or horse dander, the epidermal proteins from a host of other animals, the proteins of the pollen grain from all the important pollinating plants, the proteins of nearly all foods eaten and of a rather large miscellaneous group of other substances have all been separated out in relatively pure state and are used for testing allergic persons. The test is very simple. A small amount of the protein solution is either applied to a minute scratch in the skin or injected into the skin with a hypodermic needle. If the patient is not sensitized no reaction occurs. If he is allergic to the particular protein, a small urticarial wheal or hive occurs at the site of testing. This lasts some minutes, then gradually fades. The protein has come in intimate contact with the body cells at the cut in the skin and the hypothetical protein poison has been liberated but in such small amounts that only a local reaction occurs.

The first function of the examiner is to find out to what proteins the patient is sensitive, for sensitization is usually multiple. Following this relief is obtained either by avoidance of the particular food, pollen or other substance or through gradual desensitization or immunization by repeated injections of small amounts, of increasing size so that the victim will eventually tolerate many times the dosage or exposure that would otherwise have given rise to acute symptoms.

We do not know precisely why repeated injections of increasing amounts of the poisonous protein will eventually relieve the symptoms. The most popular

explanation suggested is that with the continuous or quasi-continuous introduction of foreign protein the velocity of the chemical reaction is slowed up so that the protein poison is liberated more and more slowly and less explosively, while the body cells themselves become increasingly resistant or impervious to the action of the poison itself.

While other factors play a part the basic cause for hay fever and asthma appears to be the inhalation or ingestion of some foreign protein and its absorption through the mucous membrane of the respiratory tract or the gastro-intestinal tract. There is evidence that once having become sensitive to the protein of a food an individual's barriers against the subsequent absorption of this protein are let down to a degree, so that the protein passes through the intestines or respiratory mucous membranes and into the circulation without being completely digested, as it should be.

Among the inhalants which produce asthma or hay fever we should mention the pollens; animal epidermal emanations, such as horse dander; the dust from feathers, as in feather pillows; or rabbit hair, which is a constituent of felt and is found in one form or another in nearly every home; orris root, the dried and powdered root of the iris, a constituent of most face powders and various cosmetics, and some dusts. Among the less common causes of inhalant allergic attacks I might mention as examples the protein from dried glue in furniture; pyrethrum, a constituent of insect powders; the furs of wild animals found in fur coats or mounted as trophies of the chase, and feathers from sparrows nesting just outside open windows. Often the search for the causative protein is a long-drawn-out affair. A patient may be sensitive to almost any known food. Not infrequently it is necessary to test him with a hundred or more different proteins before all the possible causes for allergic manifestations have been eliminated.

We rarely attempt desensitizing injections for the foods, since they are more easily avoided. Likewise asthma or sneezing due to feather sensitization is sometimes relieved by the simple procedure of changing from feather pillows to silk floss or kapok and removal of dust from the bedroom. A horse asthmatic need but avoid horses to remain free from symptoms. But he is a poor risk for serum treatment for other diseases, such as diphtheria or pneumonia, for most serums used in medicine are horse serums. But dust, pollen granules and orris root are not so easily avoided. Nowadays, wherever women are, there also in the dust is an abundance of orris root from cosmetics. Churches, theaters, schools, stores and homes are rarely free from orris root. Its avoidance is difficult, indeed. Ragweed pollen may be carried on the wind for ten miles, and during the

pollinating season its avoidance is impossible. Those who can afford it may take an ocean voyage or sojourn at the seashore where the prevailing wind is from the ocean or go to the woods where ragweed is less abundant, but the majority of hay fever sufferers must depend upon desensitization for relief. Fortunately, this method of treatment has been so perfected that in expert hands from 75 to 100 per cent. relief may be had in most cases. Unfortunately the so-called serum treatment for hay fever and asthma has been inefficiently given by physicians who have not made a special study of allergy, with the consequence that the results have not been good and the patient has denounced the method as a failure, whereas had it been properly supervised it would have been more successful.

Not all people develop allergy. Conservatively put, about 10 per cent. of the general population is predisposed. The remainder never develop the disease. Curiously enough, the tendency appears to be hereditary. There are several diseases in which we find evidence of an hereditary predisposition, and allergy is one of them. Among the others I might mention hemophilia, some forms of insanity, certain rather rare diseases of the bones and of the spinal cord, gout, and probably rheumatism and high blood pressure. The list is not complete.

There is a record of a family in France in which members of four generations were sensitized to egg. But this is not the usual case. It is not the specific sensitization which is inherited, but the tendency to become sensitive. In one generation there may be a sensitization to timothy pollen, in another to strawberry protein and in yet another to chicken feathers. It is probably only the tendency that is inherited. Not only this, but the allergic explosion does not necessarily manifest itself in the same way in the various members of the family. One may have asthma, another hay fever, another migraine or sick headache and yet another eczema. In my own work I have made a careful study of an interesting family. The boy, sensitive to wheat, chocolate and strawberry, has asthma. His brother has had the hives. His mother, sensitive to wheat, had suffered in the past from eczema. The maternal grandmother was a victim of migraine, while the paternal grandmother was subject to hay fever from exposure to the pollen of daisy, and acute colitis or gastro-intestinal upset which always followed the ingestion of clams. She would also develop hives after taking quinine. An uncle developed hives after eating strawberries.

The evidence so far indicates that the inheritance of allergy follows the Mendelian law probably as a dominant characteristic. Where the inheritance is bilateral the symptoms usually become manifest

earlier and in more members of the family than when it is unilateral.

The biologist will be especially interested in pollens as the cause of asthma and hay fever. Roughly there are three hay fever seasons in which pollens are causative factors, an early spring period during which tree pollens are in the air, early summer when the grasses are pollinating and late summer or early autumn when the compositae, particularly the ragweeds, are shedding their pollens. Formerly it was thought that goldenrod was a chief malefactor, while the more drab and less noticeable ragweed next to it remained unsuspected. As a general principle we may say that the brightly colored plants are far less important than are those without brilliant flowerings. The colorful plants usually possess heavy sticky pollens which are carried from plant to plant on the bodies of insects and never reach a high concentration in the air, certainly not at any great distance from the plants. Goldenrod, rose, apple blossoms, daisy, sunflower and the like fall within this group of insect pollinated plants. They may and do cause symptoms when the sensitive individual stays for some time within, say, a hundred yards of the plant but rarely otherwise. With a sunflower sensitive patient it is only necessary to destroy these plants in the immediate neighborhood and desensitizing injections are rarely needed.

But the drab plant without brilliant colors to attract insects possesses much lighter pollen grains, which are wind-borne. It has been estimated that a single ragweed plant will shed millions of pollens in twenty-four hours. As I have said, on a dry windy day they are carried many miles. At my pollen station on the roof of the Medical Arts Building in the heart of Richmond I obtained practically the identical pollen count that I did at my other two stations, one in the residential district and one in the town of Ashland. These pollens one can not avoid, and desensitization is necessary.

While there are quite a number of tree pollen sensitive individuals it has been thought that since the pollinating season for trees was of but two or three weeks' duration desensitization was not necessary. But, as I have said, sensitization is usually multiple, and with sensitization to several trees which pollinate at different times tree pollen sensitization may become quite a problem. Indeed, one may be sensitive to several varieties of one tree. There are said to be some sixty-five varieties of oaks in the United States, and these do not all pollinate simultaneously. Furthermore, some trees have a relatively long pollinating season. Mountain cedar in parts of Texas sheds enormous quantities of pollens from before Christmas to mid-February, and it has been discovered

that in this section the so-called winter cold is much more often a winter hay fever. Persons have been found sensitive to maple, willow, alder, birch, hawthorn, oak, walnut, ash, cottonwood, box elder, sycamore, hickory, elm, cedar, pecan, pine and apple. And the list is not complete, for, as pollens from other trees are being obtained and patients are being tested to them, still other positive reactions are being observed.

The most important grasses are timothy, orchard grass, red top and June grass, but there are many others.

As might be expected, the plants responsible for symptoms vary in different sections of the country, depending upon the predominating local flora. The physician treating allergy in Texas selects a slightly different group of pollens from one who is working in Oklahoma or California or Virginia or the New England states. Indeed, for best results in relieving the victims of hay fever and asthma a botanical survey of the local section must be made. One of the most comprehensive local surveys of this sort so far as I know is that made under the direction of Ray M. Balyeat, of Oklahoma City, covering the state of Oklahoma. As a result of these studies Balyeat finds that even in different sections of the one state different plants are chiefly responsible for symptoms. And since success in treatment depends upon finding the chief causative pollens it is obvious that good results will be directly proportional to our knowledge of the nature, distribution and abundance of the local flora.

I trust that in this survey of a part of the field of allergy I have been able to establish my conception that the study and treatment of allergic diseases is primarily a biologic problem in the strict sense of the term and might well be designated a branch of applied biology in which the subject of investigation happens to be the human being. The allergist who delves deeply into his field must necessarily become a student of the activity of living matter, for in the last analysis the basis of anaphylaxis and of allergy is the vital activity of the living cell and its reaction to environmental alterations.

WARREN T. VAUGHAN

RICHMOND, VA.

### EDGAR FAHS SMITH

ON the evening of Thursday, May 3, 1928, Dr. Edgar Fahs Smith, thirteenth provost of the University of Pennsylvania, died in the university hospital, following an illness contracted only a few days previously.

The announcement of Dr. Smith's death came as a thunderbolt to his many friends, as he had been in

apparent good health. Within a few hours men in every part of the world were mourning his loss. Thousands of the alumni, the faculty and the student body felt that they had lost one of the staunchest of friends and counsellors. The people of the city of Philadelphia, where he lived and labored for half a century, recognized him as one of their foremost citizens. The flags upon the municipal buildings were lowered to half-mast as a tribute to his memory. From every part of the United States messages of sympathy were received, testifying in the highest terms to the esteem and admiration in which he was held.

His fifty years with the University of Pennsylvania, which he faithfully served as teacher and administrator, will always be referred to as one of the most important periods in the history of the institution; his contributions to science during that period won for him the highest tributes of the scientific world.

In his chosen field he was invariably referred to as one of the most eminent American chemists and some of his investigations and discoveries have been of the utmost value to the industrial world. As a result of his researches, which were generously contributed for the advancement of science, he made himself a true benefactor of mankind.

As a teacher he was interesting and inspiring, always patient and painstaking; his advice was freely sought and generously given; no wonder that he should be *Beloved of Pennsylvania Men*.

As a man he was deeply religious, unassuming, easily approachable, companionable, sympathetic, of quiet and lovable disposition and always generous.

Dr. Smith was born at York, Pennsylvania, May 23, 1854. His early education was received in the York County Academy, and in 1872 he entered the junior class of Pennsylvania College at Gettysburg, from which he was graduated in 1874 with the degree of bachelor of science. While a student at Gettysburg, his interest in the study of chemistry and mineralogy attracted the attention of Dr. Samuel P. Stadler, who urged him to specialize along those lines. This was the beginning of an eventful career. He entered the University of Göttingen, Germany, where he studied under the celebrated Frederick Wöhler, and was graduated in 1876 with the degrees of A.M. and Ph.D. In 1926 the University of Göttingen again honored Dr. Smith by renewing his doctor of philosophy degree for his "fifty years of science as a teacher and investigator."

Upon returning to America he was appointed instructor in chemistry at the University of Pennsylvania, which position he held until 1881, when he accepted the Asa Packer professorship of chemistry at Muhlenberg College; he remained here for two

years and in 1883 went to Wittenberg College, Springfield, Ohio, as professor of chemistry. In 1888 he was recalled to the professorship of chemistry at the University of Pennsylvania, serving in this capacity until 1907, when he became Blanchard professor of chemistry, which chair he held until 1920, when he retired and was made emeritus professor of chemistry. In 1898 he was elected vice-provost, holding the office until 1911. Upon the retirement of Dr. Charles C. Harrison, he was elected provost of the university.

During his long connection with the University of Pennsylvania Dr. Smith was the recipient of many honorary degrees in recognition of his contributions to the field of science. Upon three occasions the University of Pennsylvania conferred honorary degrees upon him; doctor of science in 1899, doctor of laws in 1906 and doctor of medicine in 1920. Dr. Smith's other honorary degrees were:

*Sc.D.* University of Dublin, 1912; Yale, 1914; Lafayette, 1924; Wittenberg, 1927.

*Chem.D.* University of Pittsburgh, 1915.

*LL.D.* Wisconsin, 1904; Pennsylvania College, 1906; Franklin and Marshall, 1909; Rutgers, 1911; University of Pittsburgh, 1912; University of North Carolina, 1912; Princeton, 1913; Wittenberg, 1914; Brown, 1914; Allegheny, 1915; Queens College, Ontario, 1919; Temple, 1922, and Dickinson College, 1925.

*L.H.D.* Muhlenberg College, 1911.

*Litt.D.* Swarthmore, 1918.

Aside from his activities as a teacher, investigator and administrator, he was the author of many scientific works on chemistry. His "Electrochemical Analysis," which appeared in 1890, went through ten editions, including translations into French, German, Italian and Russian. His translations of Richter's "Inorganic Chemistry" and Richter's "Organic Chemistry" likewise passed through many editions and rendered a valuable service to English-speaking chemists. In addition to these Dr. Smith was the author of numerous books on the history of chemistry, including "Chemistry in America," 1914; "Robert Hare," 1917; "James Woodhouse," 1918; "Chemistry in Old Philadelphia," 1918; "Priestley in America," 1920; and "Old Chemistries," 1927. Among his many brochures on the history of chemistry are included "A Half Century of Mineral Chemistry in America, 1876-1926"; "Early Science in Philadelphia," 1926; "Joseph Priestley" (Priestley medal lecture), published in *SCIENCE*, 1926.

Dr. Smith was elected a member of the National Academy of Sciences in 1898, was president of the American Philosophical Society from 1902 to 1908,

and was president of the American Chemical Society in 1895, and again in 1920 and 1921. He was elected president of the History of Science Society for 1928.

He was an honorary member of the American Chemical Society, the American Electrochemical Society, the Société de Chimie Industrielle of France, the American Institute of Chemists, the Philadelphia College of Pharmacy and Science, the Chemical, Mining and Metallurgical Society of South Africa, and the Chemists Club of New York. He was a member of the Phi Kappa Psi Fraternity, and of Phi Beta Kappa, Sigma Xi and Phi Lambda Upsilon societies.

In 1893 he was a member of the jury of awards of the Chicago Exposition and a member of the United States Assay Commission in 1895, 1901-1905. In 1902, he served as an advisor of the Carnegie Institution, and from 1914 to 1920 he was a trustee of the Carnegie Foundation. From 1911 to 1922 he was president of the Wistar Institute of Anatomy.

Dr. Smith twice served as a member of the Electoral College for Pennsylvania—1917 and 1925. In the latter year he was president of the Electoral College. In 1919 he was a member of the commission for the revision of the constitution of Pennsylvania. Following the World War, in 1921, President Harding appointed Dr. Smith to the board of technical advisors in connection with the disarmament conference. He also served as chairman of the international committee on poison gases and high explosives.

For his distinguished service in the field of chemistry, Dr. Smith was made, in 1923, an officer of the Legion of Honor of France. In 1914, the Franklin Institute awarded him the Elliott Cresson medal for his work in electrochemistry, and in 1922 Columbia awarded him the Chandler medal for his contributions in historical chemistry.

On September 9, 1926, the American Chemical Society awarded him the Priestley medal for his distinguished services to the science of chemistry.

In connection with his period of service as provost of the University of Pennsylvania from 1911 to 1920, inclusive, a few references to the results of his administration are interesting. During that ten-year period, the student enrolment and the teaching staff were doubled; the Henry Phipps Institute was realized and incorporated in medical teaching; the Evans Dental Institute Building was erected and dedicated; the Duhring bequest of more than one million dollars was received; a maternity home erected and the surgical pavilion started; the merger of the Medico-Chi and Polyclinic Hospital with the University Post-Graduate School of Medicine was consummated; division of the college into (a) College, (b) Towne Scientific School, (c) Wharton School, (d) School of

Education; division of the department of engineering into (a) mechanical engineering, (b) electrical engineering; college courses for teachers developed; extension courses throughout the state incorporated; university's educational influence extended along many lines, and made to serve home, state and nation; marked emphasis was laid on research in every department.

The long list of Dr. Smith's investigations in many fields of chemistry need not be detailed here. Chief among them were electrochemistry, the complex inorganic acids, the rare earths and the revision of the atomic weights of the following elements: palladium, molybdenum, selenium, tungsten, tantalum, columbium, boron and fluorine. His investigations on the rarer elements—tungsten, molybdenum, vanadium, columbium, tantalum, rubidium and caesium—have been numerous.

Mrs. Edgar F. Smith has donated to the University of Pennsylvania Dr. Smith's valuable collections of historical books, pamphlets, letters and engravings relating to chemistry which will be preserved intact in his office in the John Harrison Laboratory, where they will be available to chemists for study and research.

The staff of the department of chemistry have resolved to perpetuate the memory of Dr. Smith by annually observing the birthday

Of one, who by his precepts, initiative and industry exerted upon us as individuals, upon this staff as a group, upon the entire University and, to no inconsiderable degree, upon the affairs of the world, an influence that could only be exerted by a Master of his chosen profession, an inspiring teacher, a considerate and tolerant advisor.

In sight of the laboratory which Dr. Smith planned and in which he labored for so many years there stands on the campus of the university, surrounded by nature's green, a statue, bearing the fitting legend:

EDGAR FAHS SMITH

Provost 1911-1920

Teacher Investigator Friend

WALTER T. TAGGART

## SCIENTIFIC EVENTS

### A THIRD EXPEDITION TO THE ANTARCTIC

COMMANDER DOUGLAS GEORGE JEFFERY, who was a member of Sir Ernest Shackleton's last South Pole Expedition, announced on June 6 that he was planning to lead an American-financed expedition next September into the Antarctic to define the boundaries from Grahams Land south to Ross Sea, and to dis-

cover whether the Antarctic continent was actually two or more bodies of land. Among those who have been asked to accompany him are Captain Argles, who is a pilot for one of the proposed transatlantic flights, and three other veterans of Sir Ernest Shackleton's explorations, Dr. George Vibert Douglas, of McGill University, a geologist, Dr. A. H. Macklin, of Dundee, surgeon on the *Endurance* and *Quest* voyages, and Mr. J. W. S. Mar, B.Sc., of Aberdeen, a biologist.

The expedition will take with it a large aeroplane, which is now being built, and a small Amphibian similar to that used by Captain Wilkins. The larger aeroplane will have a capacity of 1,500 gallons of petrol and a cruising radius of 6,000 miles. There may be a flight across the South Pole, although that is not the object of the enterprise. Commander Jeffery expects to establish a base some time in November far down the west coast of Grahams Land, and from there will explore on that side eastward to Coats's Land. He said that it was probable that they might cooperate by wireless with the Byrd and Wilkins expeditions, which would be on the opposite side of the Antarctic Continent. They would be able to check meteorological data, and the bases on each side would serve for transeontinental flights.

The expedition will go south in a vessel of the deep-sea mine-sweeper type. Its personnel will be limited to 25 at most. It is planned to start the return journey in May.

### PROGRAM OF RESEARCH IN COAL AND METALLURGY AT THE CARNEGIE INSTITUTE OF TECHNOLOGY

A PROGRAM of fourteen research studies in coal mining and metallurgy will be carried on during the year of 1928-29 under the joint auspices of the Carnegie Institute of Technology, the U. S. Bureau of Mines and two advisory boards of mining and metallurgical engineers and executives. To make the investigations, eleven college graduates have been appointed to research fellowships, and, in addition, a research engineer, an assistant research engineer and an analyst have been appointed.

The new program is similar in scope to those of the past few years that have been conducted under the same auspices. The research fellows, in carrying out their investigations, will be candidates for the degree of master of science to be awarded by the institute. The reports of the studies will probably be published as in the past.

Appointees to research fellowships are Julius R. Adams and Kenneth Metcalfe, Rose Polytechnic Institute; Kenneth M. Irely, Monmouth College; John E. Jacobs and Henry Seaman, Carnegie Institute of

Technology; Malcolm F. Judkins, University of Washington; Walter O. Krebs, Yale University; W. E. Marshall, Georgia Institute of Technology; Egbert Shetter, Ohio University; James A. Younkens, Penn State College, and Adam H. Hartswick, Penn State College. In addition, C. F. Christopher, research engineer; Frank Morris, analyst, and A. D. Meyer, assistant research engineer, will assist in making special studies in the program of research.

The following studies are planned:

**Coal Mining.** 1. Relation of particle size and temperature rate of burning; characteristics of flames of powdered coke and coal; 2. The composition of the oils and heavy tar from the distillation of coal at low temperatures; 3. Forms of sulphur in the Pittsburgh Coal Bed; 4. The chemical constitution of regenerated ulmins; 5. Effect of fusian and related inerts on the properties of Pittsburgh Coal with particular reference to coking properties; 6. Chemistry of decay in relation to peat and coal formation.

**Metallurgy.** A study of the cause and control of abnormality in case carburized steel; 2. Formation and identification of inclusions; 3. Distribution ratio of iron oxide between slag and metal; 4. Method of determining inclusions; 5. Viscosity of open hearth slags, and three studies in plant work relating to the physical chemistry of steel making.

Four of the studies will be financed by the Carnegie Institute of Technology, six by twenty-nine contributing companies representing the metallurgical industries, one by the International Combustion Engineering Corporation, one by the National Coal Association and two by the Pittsburgh Coal Company.

### THE FRANKLIN MEMORIAL IN PHILADELPHIA

ANNOUNCEMENT was made on June 22 that a memorial to Benjamin Franklin will be created in Philadelphia on the Parkway at a cost of \$7,000,000 for construction and endowment. This has resulted from a merging of effort by the Franklin Institute of the State of Pennsylvania and the Benjamin Franklin Memorial, Inc.—the latter sponsored by the Poor Richard Club.

The tentative plans call for a monumental building a square in length. Its dominating feature, architecturally, will be a domed structure of the type of the Pantheon in Rome, containing a memorial chamber, in which it is planned to install a statue of Franklin.

Close by this memorial chamber will be housed a museum showing the status of the graphic arts in Franklin's time, and illustrating the development of printing, engraving and paper-making.

The rest of the structure will be devoted to the scientific and technological museum, which the Frank-

lin Institute has been planning, with a library with a capacity for 250,000 volumes, in the field of physical and mathematical sciences—the institute already has 120,000 volumes—two auditoriums and committee rooms and offices for the Franklin Institute.

Already \$3,000,000 is available for the undertaking, including funds of the Franklin Institute and some subscriptions. The executive committee of the Benjamin Franklin Memorial, Inc., expects to raise an additional \$4,000,000. It is planned that about \$4,000,000 shall be spent on construction and \$3,000,000 be devoted to endowment. A five-acre site on the Parkway will be provided by the city, which has the advantage that users of the scientific library, which is to be a feature of the memorial, would find themselves only a stone's throw away from two other important libraries—the library of the Academy of Natural Sciences, especially rich in the biological and geological sciences, and the Free Library.

### APPOINTMENTS AT THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE Board of Scientific Directors of The Rockefeller Institute for Medical Research announces the following appointments and promotions:

#### NEW APPOINTMENTS:

##### *Associates*

Dr. Robert R. Hannon.  
Dr. Fritz Lange.  
Dr. Henry R. Muller.  
Dr. Cornelius P. Rhodes.

##### *Assistants*

Dr. Robert B. Corey.  
Dr. Martin H. Dawson.  
Dr. Malcolm Dole.  
Mr. Elmer E. Fleck.  
Dr. Thomas Francis, Jr.  
Dr. Donald C. Hoffman.  
Dr. Christopher Johnston.  
Dr. Currier McEwen.  
Dr. Norman S. Moore.  
Dr. James F. Pearey.  
Dr. Albert L. Raymond.  
Dr. F. Duran Reynals.  
Dr. Alexander Bothen.  
Dr. Charles A. Slanetz.  
Miss Evelyn B. Tilden.

#### PROMOTIONS:

##### *Associate to Associate Member*

Dr. Louis A. Mikeska.

##### *Assistant to Associate*

Dr. Edwin L. Gustus.  
Dr. Charles H. Hitchcock.  
Mr. Thomas P. Hughes.  
Dr. William S. Tillett.  
Dr. Perrin H. Long.

*Fellow to Assistant*

Mr. Philip R. Averell.

Dr. Rene J. Dubos.

## RESIGNATIONS:

Dr. Jacob J. Bronfenbrenner has accepted appointment as professor and head of the department of bacteriology and immunology at Washington University Medical School.

Dr. E. V. Cowdry has accepted appointment as professor of cytology in the department of anatomy of Washington University Medical School.

Dr. Fred W. Stewart has accepted appointment as assistant pathologist at the Memorial Hospital, and associate in pathology at Cornell University Medical School, New York City.

Dr. Clifford L. Derick has accepted appointment as assistant professor of medicine at the Harvard Medical School and physician to the Peter Bent Brigham Hospital.

## SCIENTIFIC NOTES AND NEWS

MATTHEW W. STIRLING, of Berkeley, California, ethnologist and explorer, has been appointed chief of the U. S. Bureau of American Ethnology under the Smithsonian Institution, to succeed Dr. J. Walter Fewkes, who retired from active administrative duties last January.

SIR ERNEST RUTHERFORD, Cambridge, and M. Jean Perrin, professor of physical chemistry at the Sorbonne, have been elected associates of the Royal Academy of Belgium.

DR. HENRI DESLANDRES, director of the observatory of Paris and Meudon, has had conferred upon him an honorary doctorate of mathematics and physics by the University of Leyden.

THE degree of doctor of science has been awarded by the University of Cambridge to F. J. W. Whipple, superintendent of the Kew Observatory and assistant director of the Meteorological Office, England.

DR. JOHN R. MOHLER, chief of the U. S. Bureau of Animal Industry, received the honorary degree of doctor of science on June 2 from the University of Maryland.

At the commencement of the University of Pittsburgh the degree of Sc.D. was conferred upon B. Preston Clark, of Boston, in recognition of his work upon the *Sphingidae* of the world. On the same occasion, Dr. W. J. Holland, in recognition of his approaching eightieth birthday and the fact that for forty years he has been a trustee of the university, during ten of which he was its chancellor, was given the honorary degree of L.H.D.

THE honorary degree of doctor of science has been conferred by the University of Pennsylvania upon Dr. James M. Anders, professor of medicine in the uni-

versity graduate school of medicine, and on Dr. Milton J. Greenman, director of the Wistar Institute of Anatomy and Biology.

AMONG those receiving honorary degrees from the University of Washington on June 18 were Dr. Fay Cooper Cole, professor of anthropology at the University of Chicago, and Dr. and Mrs. George Dick, of the McCormick Institute of Infectious Diseases, Chicago.

THE honorary degree of doctor of science was conferred upon Samuel Robinson Williams, professor of physics at Amherst College, at the commencement exercises of Grinnell College on June 5.

At commencement on June 11 De Pauw University conferred the honorary degree of doctor of science upon two brothers, Professor O. M. Stewart, head of the department of physics at the University of Missouri, and Professor G. W. Stewart, head of the department of physics at the University of Iowa.

THE honorary degree of doctor of science was conferred upon Dr. Reinhardt Thiessen, research chemist and microscopist of the U. S. Bureau of Mines at Pittsburgh, at the annual commencement exercises of Lawrence College, Appleton, Wis., on June 11.

AMONG those receiving honorary degrees at the 160th annual commencement exercises at Brown University on June 18 were George H. Sherwood, curator of the American Museum of Natural History, and Dr. Harvey N. Davis, president-elect of Stevens Institute of Technology.

DR. EDWARD B. MATHEWS, professor of geology at the Johns Hopkins University, received the honorary degree of doctor of science from Colgate University on June 19.

E. A. REEVES, map curator and instructor in practical astronomy and surveying to the Royal Geographical Society, has been awarded the society's Victoria medal. The medal is given occasionally for purely scientific attainments, the last award being in 1927, to Sir Charles Close.

WE learn from *Nature* that the council of the Royal Society of Edinburgh has awarded the Keith prize for the period 1925-27 to be divided equally between Professor T. J. Jehu and R. M. Craig for the joint series of papers which have recently appeared in the publications of the society on the geology of the Outer Hebrides, and the Neill prize (1925-27) to Professor Arthur Robinson, professor of anatomy in the University of Edinburgh, for his contributions to comparative anatomy and embryology. The Bruce prize for the period 1926-28 has been awarded to Professor Dr. H. U. Sverdrup, of the Geophysical Institute,

Bergen, for his contributions to the knowledge of the meteorology, magnetism and tides of the Arctic.

At the commencement exercises on June 9, of the University of Illinois, College of Medicine, Dr. Edward A. Boyden, associate professor of anatomy, was awarded the Beaumont memorial prize of \$100 in recognition of his research on physiology of the gall-bladder. This prize is the income from a fund donated by Dr. Frank Smithies in 1925.

THE secretary of state has appointed Dr. Aleš Hrdlička, of the U. S. National Museum, a member of the cooperating committee on the part of the United States to the Seventh American Scientific Congress, to be held at San José, Costa Rica, in 1929.

DR. G. W. THOMPSON, of Brooklyn, has been elected president of the American Society for Testing Materials, to succeed Professor H. F. Moore, of the University of Illinois. K. G. McKenzie, of New York City, was elected vice-president.

NILS A. OLSEN has been appointed chief of the U. S. Bureau of Agricultural Economics. Mr. Olsen has been assistant chief of the bureau in charge of research since May, 1925, and takes the position made vacant by the resignation of Lloyd S. Tenny, who has been appointed to an executive position with the Associated California Fruit Industries, Inc.

ALDO LEOPOLD, associate director of the U. S. Forest Products Laboratory at Madison, Wis., will leave the laboratory July 1 to engage in private work as consulting forester, specializing in game management.

DR. ROE E. REMINGTON, formerly associate professor of biological chemistry at the North Dakota Agricultural College and for the past year Shevlin fellow in medicine at the University of Minnesota, has been appointed director of the food research laboratory of the Medical College of South Carolina at Charleston. At its last session the general assembly of South Carolina provided funds for a study of the nutritive value of foodstuffs produced in the state. The immediate problem to be taken up is the distribution of iodine in foodstuffs and waters of South Carolina.

DR. C. G. ABBOT, secretary of the Smithsonian Institution, left on June 29 for Mount Wilson to continue work on the stellar energy spectra. He expects to return about the middle of September.

DR. MELVILLE HERSKOVITS, associate professor of anthropology at Northwestern University, and Dr. Morton Kahn, assistant professor of public health and preventive medicine at the Cornell University Medical College, will spend this summer in making a

study among the Djuka, or bush Negroes, of Dutch Guiana.

SABBATIC leave for the academic year 1928-29 has been granted to the following members of the faculty of the Kansas State Agricultural College: Assistant Professor E. S. Lyons, agronomy; Professor Mary T. Harman, zoology; Associate Professor Joseph P. Scott, animal pathology, and Professor Floyd Pattison, mechanical engineering.

ERNEST L. WALKER, professor of tropical medicine at the University of California Medical School, recently returned from a fourteen months' stay in Honolulu, where he carried on investigations as to the cause of leprosy, at the invitation of the U. S. Public Health Service.

PROFESSOR D. H. WENRICH, of the department of zoology at the University of Pennsylvania, has been granted a year's leave of absence for study and research and will spend the academic year, 1928-29, at the University of California, as the guest of the department of zoology at Berkeley.

PROFESSOR R. RUGGLES GATES, of the University of London, sailed on June 23 for Canada on a botanical and anthropological expedition down the Mackenzie River. Facilities are being furnished by the Hudson's Bay Company. He is taking a cinema film camera, and is accompanied by K. Mellanby, a young botanist at Cambridge.

THE Soviet Geographic Society is sending an expedition to Central Asia, under the leadership of the explorer, P. K. Kozloff. The expedition is to last three years and will be devoted to the exploration of the Tibet plateau and the sources of the Yangtze Kiang.

THE Oxford University expedition, under the leadership of Dr. T. G. Longstaff, left on June 1 in the steamer *Gertrude Kask* for Godthaab, on the west coast of Greenland, to carry out research work there.

DR. GULBRAND LUNDE, of the University of Oslo, is leaving the United States the latter part of July. On July 24 he will address the Institute of Chemistry of the American Chemical Society on "The Geochemistry and Circulation of Iodine in Nature."

PROFESSOR JOHN DEWEY, of Columbia University, has been appointed by the University of Edinburgh to give the Gifford lectures in April and May of 1929.

DR. J. C. MCLENNAN, professor of physics in the University of Toronto, delivered the Bakerian lecture before the Royal Society on June 28 on the subject, "The Aurora and its Spectrum."

DR. MICHAEL I. PUPIN, professor of electrochemistry in Columbia University, gave the commencement address at Middlebury College, Vt., on June 18, when the college conferred on him the honorary degree of doctor of laws.

EXERCISES for the dedication of a tablet in memory of the late Professor Joseph Baker Davis were held on May 10 in the engineering quadrangle at Oberlin College.

DR. MYLES STANDISH, Williams professor emeritus of ophthalmology at the Harvard Medical School, died on June 26, aged seventy-seven years.

THE U. S. Civil Service Commission announces an open competitive examination for assistant pathologist (vegetable diseases), applications for which must be on file with the Civil Service Commission at Washington, D. C., not later than August 1. The examination is to fill a vacancy in the Bureau of Plant Industry, Department of Agriculture, Washington, D. C., and vacancies occurring in positions requiring similar qualifications. The entrance salary ranges from \$2,600 to \$3,100 a year.

THE program for the international conference arranged by the British Empire Cancer Campaign was issued recently. The conference will be held at the house of the Royal Society of Medicine in London and will extend from July 16 to July 22. Among the subjects to be discussed are the relative values of surgery and radiation in the treatment of cancer in various sites, the etiology of cancer, occupational cancer, geographical and racial prevalence of cancer and public action in regard to cancer.

ACCORDING to the *British Medical Journal* the Rockefeller Foundation has made an offer to the Government of India of the sum of £100,000 to build and equip an All-India School of Hygiene, opposite the Calcutta School of Tropical Medicine, on condition that the Government of India becomes responsible for the staff, and that the Indian Research Fund Association, which controls the medical research work in India, becomes the governing body. This will allow the present hygiene section of the Calcutta School of Tropical Medicine to be used for the much-needed expansion of that institution.

THE Soviet government of Russia has established an Institute for Textile Research which will utilize laboratories in Russian colleges and later will establish special experiment stations. The activities of the Institute will be directed along the following channels: A study of the different fibers now existing in the U. S. S. R., their physical, chemical and technological properties; the coordination of the methods

of treating these fibers; standardization of raw materials, and research work for the discovery of new fibers; the perfecting of the mechanical and chemical processes now employed by the Soviet textile industry with a view of lowering cost prices, and a study of the different phases of production.

A GROUP of engineers representing the national engineering societies sailed on the steamship *Lapland* on June 23 for Antwerp to take part on July 4 in the dedication of the American Engineers' Memorial at the University of Louvain. The memorial, a clock and carillon costing \$80,000, was presented to Louvain by the Engineering Foundation as the tribute of the engineers of America to their fellow engineers who died during the World War. About 100 American engineers will attend the ceremonies, which are to be carried out in connection with the dedication of the new Louvain Library Building, destroyed during the German invasion of Belgium and restored by American benefactions. Another event of the celebration will be the unveiling of a bronze bust of Secretary Herbert Hoover, which is to be placed in the new Library Building.

GROUND was broken on June 23 on Swarthmore College campus for the research laboratory about to be built for the Bartol Research Foundation of the Franklin Institute. The site adjoins that of the engineering buildings. Those participating were Dr. Howard McClenahan, secretary of the Franklin Institute; Dr. W. F. G. Swann, director of the Bartol Research Foundation; Dr. Frank Aydelotte, president of Swarthmore College; C. C. Tutwiler, vice-president of Franklin Institute and chairman of its committee on the foundation, and John T. Windrim, architect for the new structure.

ACCORDING to the *Journal of the Washington Academy of Sciences*, the offer of the Smithsonian Institution to take over and maintain the mycological collection of the late C. G. Lloyd, of Cincinnati, which had been without a curator since the death of the founder in 1926, has been accepted by the trustees of the Lloyd Library and Museum, and the collection has been moved to Washington and is now in process of installation. This outstanding collection of the larger fungi, gathered together during the lifetime of Curtis Gates Lloyd, contains a number of specimens variously estimated at 50,000 to 100,000, nearly 10,000 negatives of fungus subjects, hundreds of photographic prints, half-tones of all the illustrations issued in Mr. Lloyd's numerous publications, voluminous correspondence with practically all the mycologists of the world active during his lifetime, many note-books and a great mass of manuscript records

pertaining to the specimens. The collection will be maintained as a separate unit by the Office of Mycology and Disease Survey, in the Bureau of Plant Industry, under the immediate supervision of a custodian to be named by the Smithsonian Institution. It will be housed in steel herbarium cases and in a fireproof building.

THE Museum of Comparative Zoology at Cambridge has acquired the large private collection of Diptera amassed during the past thirty years by Mr. C. W. Johnson.

A 300-ACRE public arboretum in which all plants, shrubs and trees which grow in the climate will be planted will be established on the Moneypenny Farm in Yonkers, according to an announcement made by Dr. Frederick J. Pope, secretary of the William Boyce Thompson Institute for Plant Research in Yonkers. The arboretum will be open to the public and laid out on plans similar to the Arnold Arboretum in Boston.

THE new Rose Garden of the Brooklyn Botanic Garden was opened to the public for the first time on Sunday afternoon, June 24. Hereafter the garden will be open to the public every afternoon except Sundays and holidays. This garden was made possible by a contribution of \$15,000 from Mr. and Mrs. Walter V. Cranford, and the planting has been arranged from the educational as well as artistic point of view. The older horticultural varieties are placed at the north end of the garden, proceeding thence with the newer varieties in progression to the latest introductions at the south end. The border plantings represent the species of the genus *Rosa*. The planting also includes a representation of roses used for various economic purposes and roses of historical interest.

BEQUESTS made by the late Frederick Bruce, of New York, include \$25,000 each to the American Society for the Control of Cancer and the Memorial Hospital, New York, and \$10,000 to the Johns Hopkins University.

OXFORD UNIVERSITY has received from Dr. J. E. Crombie a gift of £500 towards the cost of the seismological room in the university observatory.

A GIFT of \$500,000 has been made by Max Adler, of Chicago, for a planetarium on an island off Chicago's lake front near the Field Museum.

ACCORDING to the census of 1926 the population of the Union of the Soviet Republics is 145 million as compared with only 104 million in 1897, so that in spite of the war, famine and epidemics the population has increased by 40 per cent. in the last thirty years. During this period the number of urban dwellers has increased twofold, while the increase in the rural population has been only 30 per cent.

THE government's plans for geodetic operations for the season of 1928, including cooperation with Canada in attaining a single system of leveling for the two countries and with the Carnegie Institution of Washington in studies of earthquake disturbances, were outlined on June 1 by the director of the Coast and Geodetic Survey, E. Lester Jones. The activities described relate to all the 48 states. The work includes not only triangulation and leveling but also astronomical studies for determination of latitudes and longitudes.

### UNIVERSITY AND EDUCATIONAL NOTES

GIFTS of \$365,000 were announced at the commencement exercises of Wellesley College, including \$75,000 from friends of Dr. Emilie Jones Barker, for a chair of physics.

PRESIDENT ERNEST M. HOPKINS on June 16 announced the promise of two gifts totaling \$1,500,000 to Dartmouth College for developing the honors courses, recently introduced into the curriculum.

THE legislature of New Brunswick has appropriated \$200,000 for the erection of a building at the University of New Brunswick in which will be housed a forest school, a department of geology and a library.

DR. EDWARD W. KOCH has been made acting dean of the University of Buffalo School of Medicine. Dr. Koch has been secretary of the medical faculty and head of the department of pharmacology for several years.

DR. E. J. CAREY has resigned as acting dean of the Marquette University School of Medicine, but will retain the directorship of the department of anatomy.

HARRY ISLER LANE, of Cornell University, has been appointed acting head of the department of mathematics at the University of South Dakota.

DR. RUDGER H. WALKER, assistant professor of agronomy at the Colorado Agricultural College, has been appointed assistant chief in soil bacteriology for the Iowa State College at Ames.

HENRY E. STARR, of the University of Pennsylvania, has been appointed professor of psychology at Rutgers University.

AT the University of Buffalo, Dr. Carleton F. Scofield, of Yale University, has been appointed assistant professor of psychology, and Dr. Arthur H. Copeland, assistant professor of mathematics.

DR. VICTOR T. ALLEN, assistant professor of geology in the University of California, has been appointed assistant professor of geology at St. Louis University.

At Syracuse University, Dr. Earl T. Apfel, head of the department of geology in Illinois Wesleyan University, has been appointed associate professor of geology, and Dr. Ernest Thelin, of Florida State College, associate professor of psychology and director of the psychological laboratory.

Dr. JOSEPH KAPLAN, of Princeton University, and Dr. E. L. Kinsey, of Yale University, both National Research Fellows, have been elected assistant professors of physics at the University of California.

Dr. WAYNE E. MANNING, instructor in botany in the University of Illinois, has been appointed assistant professor of botany in Smith College.

## DISCUSSION AND CORRESPONDENCE

### THE HEREDISCOPE AND ARTIFICIAL POPULATIONS

THE writer and a collaborator<sup>1</sup> have shown that there is probably much to be learned from the empirical analysis of the constants of a population the genetic constitutions of whose members are known by hypothesis. The problem attacked in the paper cited was that of the counteractive influence of assortative mating upon the negative correlation between fertility and intelligence in determining trends in the population mean in the latter trait; other factors which strongly suggest that fruitful results might be obtained from their isolation and study are incidence ratios, selection rates and degree of monogamy. Generalized, the problem is that of describing the mathematical, logical or ideal behavior of specific factors in heredity, in order that their presence may be recognized when complicated by the presence of other factors in populations of actual organisms.

Studies like that cited, however, are excessively laborious, even with the small number of genes dealt with (five); this comes about principally because a die must be thrown or a coin flipped for every appearance in a mating of a gene in the heterozygous phase, and the result recorded; in the experiment in question, twenty-five thousand is a conservative estimate of the number of dice throws necessary, although the work was continued through only five generations.

I suggest that Mr. Graves' herediscope, reported in *J. Hered.*, 1928, 19, 54-56, although designed for demonstration purposes only, embodies a principle enabling a considerable magnification of the efficiency of research with artificial populations. I can not at this writing suggest ways and means for adapting the

<sup>1</sup> Willoughby and Goodrie, "Neglected Factors in the Differential Birth Rate Problem," *Ped. Sem.*, 1927, 34, 373-393.

appliance to large-scale work; but even if it had to be reset by hand for each individual mating, the saving of labor over the dice method would be considerable, and the number of genes studied could easily be doubled.

RAYMOND R. WILLOUGHBY

CLARK UNIVERSITY

### AN IMPORTANT SOURCE OF BROAD TAPE-WORM IN AMERICA<sup>1</sup>

IN a recent paper<sup>2</sup> I reported the presence of plerocercoids of *Diphylllobothrium latum* in four species of food fishes from Lake Superior and Portage Lake, Houghton County, Michigan. Evidence was presented that the Great Lakes are probably not an important source of infested fish, because only a very small percentage of the annual consumption of these fish is taken there and it was pointed out that we had reason to believe that Canadian fish shipped to the United States to be marketed would prove to be an important source of infestation. Nearly 80 per cent. of all wall-eyes consumed in the United States are imported from Canada.<sup>3</sup> Two feeding experiments have been performed with plerocercoids taken from two shipments of wall-eyes from Lake Winnipeg, one of the most important sources of Canadian wall-eyes. In the first shipment of twenty-seven wall-eyes five plerocercoids were found. Four of these were fed to a dog from which four *Diphylllobothrium latum* adults were later recovered. One plerocercoid was found in the second shipment of twenty wall-eyes from the same lake. This larva was fed to another dog, from which a mature *D. latum* was later recovered. Both dogs were known as a result of fecal examinations to be free from *Diphylllobothrium* tapeworms before the experiments were performed.

These observations and experiments demonstrate that the eating of fish from Lake Winnipeg may be responsible for a large percentage of the cases of *D. latum* infestation in the United States—outside of the known endemic areas.

Because many of the settlers around the other Canadian lakes from which fish are shipped to the United States are immigrants from Baltic countries, it is here suggested that further investigation will

<sup>1</sup> Contribution from the Zoology Department, University of Michigan. This investigation was carried on under grant 96 awarded by the American Medical Association to Professors George R. La Rue and A. S. Warthin, of the University of Michigan, under the former of whom the work has been conducted and to whom I here express my grateful appreciation.

<sup>2</sup> *Journ. Am. Med. Ass.*, 90: 673-678, 1928.

<sup>3</sup> U. S. Tariff Comm.: Lake Fish. Tariff Information Series, no. 36, 1927.

show that the fish in several of these lakes are infested with the plerocercoids of *D. latum*.

TEUNIS VERGEER

UNIVERSITY OF MICHIGAN

### BIRDS OF THE EURASIAN TUNDRA

THE publication on April 30 of Professor Theodore Pleske's *Birds of the Eurasian Tundra* (Memoirs of the Boston Society of Natural History, vol. 6, no. 3, p. 107-485, 23 pl.) was an event of considerable interest to all students of Palearctic ornithology. This report, which is based upon the collections of the Russian Polar Expedition of 1900-1903, was printed with the income of a fund bequeathed to the Boston Society of Natural History by the late William Brewster.

Through some oversight the paper contains no reference to the fact that the author's manuscript, which was submitted in French, was translated as well as edited by Dr. Glover M. Allen. This would seem to be a case where the proverbial editorial anonymity and lack of recognition should not hold true, especially in view of the thorough scholarship evident in the work of the translator and editor.

FRANCIS HARPER,

Secretary

BOSTON SOCIETY OF NATURAL HISTORY

### PRESERVATION OF THE HEATH HEN

FOR the past several years efforts have been made to preserve the few remaining species of the heath hen on Martha's Vineyard from extinction. According to a recent report from the heath hen committee, these efforts have failed, there now being but three birds left on the island, and all these are males. The most careful of determinations has failed to reveal any female birds, and the possibility of saving the species from extinction now seems hopeless. In spite of the combined efforts of the state and bird clubs, there has been a steady decrease in numbers from 1920, when there was estimated to have been six hundred birds on the island. But even though there seems to be no possibility of saving these birds, the state will continue its efforts, and the reservation will be maintained in the hope that some unforeseen factor may arise which will place a different aspect on the situation.

BIRGER R. HEADSTROM

MEDFORD HILLSIDE,  
MASSACHUSETTS

### HYBRID WORDS

OF course I am always horrified when the Latin-English word "data" is used as if it were singular. I am equally horrified at the continued creeping into

our language of hybrid words. If we are not very careful one of the most objectionable hybrids so far will become fixed in our vocabulary. About a year ago when the word was first used I made a vigorous protest against it in the Washington daily press.

The word I have in view now is "television." Can anything worse be imagined? Happily a hundred years and more ago both our scientific and literary scholars knew a great deal more about Greek than they do about it at the present time. In fact, it may be said that the study of Greek to-day is a lost art, and the result will be further inroads into the realm of using Greek names, or at least parts of Greek names for new diseases and new discoveries. Suppose William Cullen Bryant had not been the master of the Greek tongue, he would have named his immortal poem Thanatovision instead of its appropriate name "Thanatopsis." I proposed either the word teloptiky or telopsis which would have brought it more into harmony with William Cullen Bryant nomenclature. Can we not save the language yet, with science leading in the fight? Let us form a Telopsis Society and pledge every purist in the country to join in our campaign.

H. W. WILEY

### THE WORD TO REPLACE "BELIEVE"

THE writer, during the past few years, has been closely associated in work having to do primarily with chemical patents and their causes; and in connection with the prosecution of patent applications before the United States Patent Office, particularly relative to amendments in response to actions by the patent office examiners, wherein claims in the application have been rejected on prior patents and publications, the use of the expressions "I deem" or "it is deemed" has been found very useful in presenting to the examiner the present thoughts of the applicant as to the construction to be given to the art which has been cited.

Turning again to the dictionary, it is found that "deem" is defined as follows:

To think, judge, or hold as an opinion; decide or believe on consideration; suppose.

To have an opinion; judge; think.

Opinion; judgment; surmise.

Accordingly, it may be that the use of the expression "I deem" would remove much of the ambiguity attributed by Dr. Miller to the expression "I believe."

The replacement of the expression "I believe" by "I deem" is therefore presented for consideration.

LLOYD VAN DOREN

NEW YORK CITY

## SCIENTIFIC BOOKS

*A Guide to the Constellations.* By SAMUEL G. BARTON and WILLIAM H. BARTON, JR. vii+74 pages. McGraw-Hill Book Company, London and New York, 1928.

THIS book is to be highly recommended to all who wish to become acquainted with the constellations. It will also be very useful to those with some knowledge of the stars, if they wish to do naked-eye observing or to learn more about astronomy. Although it is not intended to be a text-book, and treats each topic only briefly, still the text does contain much accurate astronomical information as well as the essential facts about the various astronomical bodies. All astronomical terms are clearly and simply defined, so that even the beginner will have no trouble in understanding the meanings. Furthermore, the definitions are well arranged, and the book contains such a complete index that it should prove to be a very satisfactory reference book for many purposes.

The main part of the book consists of seventeen excellent charts, accompanied by copious notes on each constellation. Twelve of the charts, which represent the sky for latitude  $40^\circ$  at intervals of two hours, are printed in white on a blue background, and thus resemble the sky more than does any chart printed in black. By means of the dates on the charts and the explanations, it should be a simple matter for any one to find the right chart to use at the time he wishes to observe. An interesting feature of these white and blue charts is that they show only those stars which give us as much light as stars overhead having a magnitude of 4.5. By thus taking into consideration the effect of atmospheric absorption, more stars can be put on the charts without crowding; and also the stars are shown as they actually are seen, fewer being visible near the horizon than in the zenith.

Probably many who use this book will become interested enough in astronomy to continue their reading and observations. For this reason, it is an excellent idea to have given at the end of the book some information about the societies for amateur observers, as well as a bibliography of books and magazines.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

## BIOCHEMICAL EXPERIMENTS PRACTICAL FOR ELEMENTARY BIOLOGY CLASSES

LABORATORY work in introductory biology courses usually places chief emphasis upon a morphological

study of type-forms. There is a growing tendency, however, to introduce work concerning the physiology of the structures studied. If the laboratory treatment of physiological concepts is to be adequate it should include experiments on the chemical composition and physical structure of protoplasm, osmosis, the rôle of enzymes and similar topics underlying the activities of organisms.

Such experiments are thought of as requiring the equipment of a physiology laboratory and are considered impractical for large elementary classes. Courses in introductory biology are frequently taught in laboratories unsuitable for such work, since they lack a sufficient supply of sinks, Bunsen burners, racks for reagent bottles, test-tube set-ups and similar items. The cost of installing and maintaining such equipment is prohibitive, especially since it would be used only in certain portions of an elementary biology course, much of which is devoted to other types of work. Furthermore, biochemical experiments as usually performed require a certain amount of experience in laboratory technique, hence, in large classes of inexperienced students there would be much general confusion and high breakage costs.

Many biochemical experiments, however, can be performed by large numbers of students inexperienced in laboratory procedure by a method that does not require the usual apparatus. The only supplies needed are ordinary microscope slides, alcohol lamps and 25 cc dropping-bottles for the reagents. With the pipettes of the dropping-bottles one or two drops of the various reagents are placed near one end of a slide together with a small amount of the necessary organic material. Holding the slide by the opposite end, the substances are easily heated in the alcohol flame. If the slide is held in a level position the materials remain at one end and do not overflow the edges. This method replaces the usual one of pouring into test-tubes several cubic centimeters of substances from regular reagent bottles and heating in the flame of a Bunsen burner. The biochemical reactions usually demonstrated in that way are shown with equal clarity on the ends of slides. Color changes are observed by placing the slides on a sheet of white paper. As the experiments are performed the various slides can be kept side by side for comparison with each other and with the controls. Microscopic examination is possible at any time concerning the effects of the reaction upon cell structures, which relates the experiment to living things in a way not so effective if the work is performed with commercially prepared substances. The technique is so simple that no experience is necessary for every student to perform successfully his own experiments, a fact having pedagogic values not attained if such experiments are performed by the instructor

with the regular test-tube set-up as class demonstrations only.

The dropping-bottles can be kept in small trays, supplying one tray for every five or six desks. Since materials are measured in drops, a 25 cc bottle provides for several hundred experiments. Refilling is seldom required and only small amounts of reagents are used. Slides are in every way preferable to test-tubes with reference to such points as initial cost, breakage and space for storage. Washing slides does not require the brushes and racks necessary for cleaning test-tubes.

For example, the determination of the presence of organic components in organisms is handled in the following manner. The reagents supplied in dropping-bottles are iodine solution for the starch test, Benedict's solution for the reducing-sugar test, nitric acid solution for the xanthoproteic test and tap-water. Suggested organisms and tissues to be tested are potato, apple, banana, beet, bean, onion, carrot and pieces of meat. The student may obtain from himself hair, pieces of finger nail, scrapings of cells from the inner surface of the cheek and blood from a finger. White of egg and milk can be supplied in dropping-bottles. In the case of each material a very small amount is placed near the end of each of several slides. If the substance is solid a drop or two of tap-water is added and the material is broken up with a toothpick. One or two drops of the various testing reagents are added to each of the slides, respectively. If heating is required this is done by holding it in the alcohol flame. Thus a number of organisms can be tested for the presence of starch, reducing-sugars and proteins. Lipin tests are not very practical with this slide technique. The Sudan III test can be used with milk, although the color reaction is so faint when viewed through the microscope as to be almost meaningless to the student.

The action of enzymes can also be satisfactorily studied in this manner. Several drops of saliva are placed on the ends of each of three slides, *a*, *b* and *c*. The saliva of slide *a* is boiled. Several drops of starch solution are added to each slide. Slide *b* is gently warmed without overheating, while slide *c* is kept at room temperature or is cooled. Starch solution without saliva is placed on slide *d* as a control. At two-minute intervals a droplet is transferred by means of a toothpick from each of the four slides to small drops of iodine solution placed on a separate slide. In this way it is ascertained how long starch remains in each of the four preparations. When a slide shows a negative starch test it is given the Benedict's test for reducing-sugars. The experiment not only proves the digestive action of ptyalin through the use of chemical tests, but it illustrates the heat-destruction of

enzymes at high temperatures, and shows the effects of various temperatures upon the speed of the reaction. To show the action of diastase similar experiments can be performed with starch solution by using a crushed sprouting barley seed. To show the action of sucrase an extract of crushed yeast-cells can be used with cane-sugar solution.

Hydrolysis by the catalytic action of HCl may also be illustrated. The student makes four slide preparations of scraped potato. Testing one with iodine solution he determines that a large amount of starch is present. Testing the second with Benedict's solution he ascertains that there is present only a small amount of reducing-sugars. To the third and fourth preparations he adds a drop of 1 per cent HCl solution and heats; he then neutralizes with a drop of 1 per cent NaOH solution. By applying the starch test to slide three and the Benedict test to slide four he secures evidence that the starch has been hydrolyzed to relatively large amounts of reducing-sugars. In a similar manner the sugar of beets may be tested before and after hydrolysis.

The same technique permits certain experiments concerning the physical structure of protoplasm. The reversibility of the sol and gel condition of proteins can be demonstrated by placing a small portion of a 2 per cent gelatin solution, which is in a jellied condition, upon the end of a slide and repeatedly heating and cooling it. The irreversibility of coagulation can be demonstrated by applying the same treatment to milk or egg-white. Surface tension experiments can be performed with oil and water drops placed on slides that are scrupulously clean in contrast to those that have a greasy film. The contrasting structures of oil-in-water and water-in-oil emulsions can be studied under the microscope and while the preparation is under actual microscopic observation a drop of  $\text{CaCl}_2$  solution may be added to the oil-in-water emulsion and the student can observe its disruption.

The practical advantages of this technique lie in its simplicity as to supplies required and ease of manipulation. It has been used with success in the freshman biology course at Washington Square College, New York University, by large classes of students inexperienced in laboratory procedure. Its theoretical advantage lies in the fact that it makes available to elementary classes a considerable variety of experiments illustrating the physicochemical activities of protoplasm. One reason that this most important phase of biology is not generally included in introductory courses is the impracticability of giving elementary students laboratory work in this field. The above simple experiments, cited as examples, constitute laboratory work on such topics as organic components of protoplasm, hydrolysis, catalysts, enzymes, tempera-

ture effects on organic processes, the contrasting action of acids and bases, gelation, coagulation, surface-tension and the structure of emulsions. This technique, therefore, makes possible in an introductory course of general biology the inclusion of experiments on biochemical subjects heretofore regarded as too difficult or impractical, and these subjects are the very ones most essential to any consideration of organisms as physicochemical mechanisms.

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### MARKING LIVING FISHES FOR EXPERIMENTAL PURPOSES

IN experimental investigations with fishes it is frequently desirable to be able to distinguish individuals. When more than a half dozen are used at a time this becomes somewhat of a problem. Large fishes may be "tagged" by the methods in use in the Bureau of Fisheries, but these methods are inapplicable to small fishes, such as *Fundulus*, which are commonly used for experimental purposes. Clipping or punching the fins leaves an opening for infection and interferes with the normal movements of the fish. For experiments of brief duration, stains such as mercurochrome may be used, but these wash off in a very few days.

Using *Fundulus parvipinnis*, I tried marking with a fine hypodermic needle and india ink. Excellent results were obtained when the needle was inserted under a scale from behind, holding the syringe nearly parallel to the fish's body. The introduction of the needle must be carefully made; as soon as the point "takes hold," a delicate pressure is applied to the plunger and the needle withdrawn immediately. The needle should penetrate the scale pocket but must not break through the dermis. A little practice is all that is needed to rapidly mark large numbers of fishes without injuring them. When properly done the result is a round black spot from one to two millimeters in diameter which remains intensely black for several weeks and only begins to disappear after forty to sixty days. The mark seems to be absolutely permanent on specimens preserved in formalin.

In this laboratory over three hundred fishes have been thus marked and kept under various environmental conditions for periods ranging from two weeks to several months without showing the slightest harmful effect of the marking. Any part of the fish may be marked, but I have found the sides and venter most suitable, avoiding the head and the lateral line.

A number of other inks and stains were tried, but none of them proved satisfactory, some not holding their color and others causing a harmful local irrita-

tion. With a good grade of india ink, however, it was remarkable that not even a slight swelling or distortion of the scales was apparent and not a single case of infection was seen.

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### SPECIAL ARTICLES

#### ASSOCIATION OF THE CAUSATIVE AGENT OF A CHICKEN TUMOR WITH A PROTEIN FRACTION OF THE TUMOR FILTRATE

SINCE 1911 when Rous reported on the transplantability of a chicken sarcoma a number of other fowl tumors have been transplanted and studied. The outstanding features of these sarcomata are that they can be transferred to no other species of fowls; that all, with the exception of two, differ from each other in their histology and general biological behavior on transplantation; and that the tumors in transmission from fowl to fowl retain all their finer characteristics and can be passed from fowl to fowl by filtrates and desiccates as well as by grafts of living tumor cells. While the filtrable agents obtained from the tumors have been generally referred to as viruses, their extreme specificity and the multiplicity of tumor types which are faithfully transmitted in each case by the agent seem to separate them from the virus class of disease producing agents as generally defined at the present time.

In our recent studies we have endeavored to determine more precisely the nature of the tumor-inducing agents, which possess the power to stimulate cells not only to grow but to undergo differentiation in specific ways. The present report deals with the results of the fractionation of the proteins contained in the extracts of Chicken Tumor 1 of the Rockefeller Institute series.

In the first tests differential precipitation was accomplished by dialyzing out the salts by means of the ingenious apparatus devised by Dr. J. J. Bronfenbrenner. After concentrating the Berkefeld filtrate of the tumor in Alundum thimbles lined with soluble cotton membranes, the salt content of the concentrate was reduced by electrodialysis. In the very short time of three to seven minutes, a clear, mucoid material precipitated out, for the most part about the positive pole and in the bottom of the thimble. This precipitate injected into chickens proved active in the production of tumors; while the remaining fluid, though still containing considerable protein, proved inactive. Moreover the tumor agent may be precipitated in a highly active form by electrodialysis from

the serum of tumor bearing chickens. The result of this test may be interpreted as indicating either that the active agent carries a negative charge and is attracted to the positive pole, or, as seemed more probable, that the precipitate around the positive pole is brought about by the greater concentration of acid salts in this region. In fact the latter interpretation appears to be the correct one, for by lowering the isoelectric point of the concentrate with weak acid, the same kind of precipitate is thrown down, carrying with it the active agent contained in the fluid. Furthermore this precipitate may be dissolved and reprecipitated without loss of its activity.

The degree of purity of the protein fraction which carries the active agent has not yet been determined. Preliminary tests seem to eliminate the presence of mucoprotein, as was first considered probable for no reducing substance is found after hydrolyzing with sulphuric acid. The presence of the purine bases and phosphorus suggests that the major portion of the fraction consists of a nucleo-protein. The fraction gives also a uniform Feulgen reaction<sup>1</sup> of the so-called thymonucleic acid group.

Although no definite conclusion can be drawn at the moment from the results reported, yet when they are considered in the light of known properties of the chicken tumor agent, the probability of its enzyme-like nature is strengthened.

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## A "FOSSIL" CAMEL RECENTLY LIVING IN UTAH

THE fragmentary skull described below was submitted to the writer for examination by Professor A. L. Mathews, of the University of Utah, at present lecturer in paleontology in the University of Chicago. It consists of a practically complete braincase and most of the palate. The bone is perfectly fresh in appearance; no replacement has occurred; a bit of dried muscle is still present on the basioccipital. Concerning the find Professor Mathews states:

The specimen was discovered by two high-school boys of Fillmore, Utah, who, at the time, were exploring the igneous buttes some twenty miles south and west of that village. It was found about two hundred feet back in a cave, buried under about three or four feet of fine dry eolian deposit, which was easy to excavate. The cave is one of the many caverns formed in the old lava beds of

the district, which, according to Gilbert,<sup>1</sup> are post-Bonneville in age.

All its characters, including those of the teeth and tympanic region, show it to belong to the Camelidae. Its size is about that of the existing old world camels and this, together with a number of anatomical features, rules out reference to the South American llamas. The most obvious explanation seemed to be that the skull was that of one of the imported dromedaries which were released in the southwest in the 70s.

This is not the case. Comparison has been made with both the dromedary and the bactrian camel, through the kindness of Dr. Osgood, of the Field Museum of Natural History, and a large number of differences became apparent, some of which are noted below. While it seemed absurd that this fresh skull was that of a Pleistocene form, it agreed so well with Merriam's figures of La Brea camelids<sup>2</sup> that comparison with the Pleistocene *Camelops* from that locality was arranged through the kindness of Dr. W. D. Matthew, of the University of California. With the skulls of both the living camels and the La Brea type before me, the identity of the Utah specimen with *Camelops* is unmistakable. Some fourteen points of comparison have been noted; a few of them are presented here:

(1) The lateral occipital openings are large in the Utah specimen. They are large in the La Brea forms; small in the old world camels. (2) The paroccipital process and mastoid are closely united externally. The same is true of the La Brea forms. The two diverge, leaving a groove between them, in the old world camels. (3) The basisphenoid-presphenoid in the Utah specimen form a prominent V-shaped ridge, as in *Camelops*. They are smoothly rounded in the living camels. (4) The glenoid is high up on the skull, about one and one half inch above the level of the basisphenoid, in the Utah specimen and the La Brea forms, while in the living camels this point is almost on the level of the basisphenoid. This causes a striking difference in the contours in the side of the skull, the origin of the zygomatic arch, etc. (5) In both the Utah specimen and the La Brea camels the post-glenoid opening is small, and an additional foramen (noted by Merriam) is present at the outer end of the glenoid. This foramen is absent in the living camels and the post-glenoid foramen is large. (6) While the edge of the orbit is not shown in the specimen, the anterior end of the masseteric rugosity and the situation of the portion of the maxilla enclosing

<sup>1</sup> Gilbert, G. K., 1890. Lake Bonneville. Mon. U. S. Geol. Surv. 1, 329-332.

<sup>2</sup> Merriam, J. C., 1913. Univ. Calif. Bull. Dept. Geol. 7, pp. 305-23.

<sup>1</sup> We are indebted to Dr. E. V. Cowdry for calling our attention to this reaction.

the second molar show that the orbit can not have been situated as in *Camelus*, but much higher and more posteriorly. This compares exactly with the La Brea specimens.

The Utah specimen differs from the dromedary in eleven of the fourteen points studied, from the bactrian camel in ten, from Merriam's "*Camelops* near *hesternus*" in two, from *C. hesternus*, as identified by Merriam, in no important feature whatsoever. This skull is unquestionably to be referred to the Pleistocene *Camelops* and probably *C. hesternus*.

This genus, however, is assumed to have been extinct for a period of (roughly) half a million years. Hay, as a result of his study of the Iowa Pleistocene, concluded that camels had ceased to exist in this continent after the first (Aftonian) interglacial stage. This view has gained general acceptance, and the presence of a "camel" in a fauna has usually been sufficient cause for assigning it to an early position in the Pleistocene sequence. This may be true for the eastern United States; but in the west, at any rate, the story of the camel must have been an entirely different one.

The exact conditions under which the skull was discovered are unknown; it is highly desirable that they be carefully investigated. The cave is situated in a lava flow which, as Gilbert has shown, occurred after the highest ("Bonneville") stage of Lake Bonneville. This stage is generally believed to have been contemporaneous with the last (Wisconsin) glaciation,<sup>3</sup> and there is no definite evidence for placing it at an earlier date, other than a discovery of fossil bones in the Lake Lahontan basin discussed below. We can not conceive of a first interglacial animal being present in a cave formed after the fourth glaciation, except by reburial; and this skull is much too fragile to have been transported by natural agencies.

The muscle tissue has been submitted for examination to Dr. F. C. Koch, of the department of physiological chemistry, who reports:

A very small particle of the brown material taken from the basioccipital region of the skull, when heated upon platinum foil, gives the typical test of a protein. That is, the typical odor, the charring, and the final burning. This certainly indicates that the material is chemically of organic nature and probably protein in character.

How long can organic material be preserved as such on the skeleton of a dead animal? In the entire absence of water, as in a dry cave in desert country, bacterial action can be prevented and it might last almost indefinitely, as mummification shows. But this

<sup>3</sup> Hay, O. P., 1927. Publ. Carnegie Inst. Washington pub. 322B, p. 141.

region is not desert; the annual rainfall at Fillmore is about fifteen inches, similar to that of much of the plains country, and in the past the climate appears to have been much more humid than at present. It is very probable that this skull is several centuries old; it is possible that it is several thousands of years old; but that it dates back half a million years or so to the first interglacial is utterly impossible.

The Pleistocene "camel" appears to have survived in the Great Basin region until recent times. Other discoveries in the last few years have also tended to shake our belief in the great antiquity of the camel and other extinct forms. For example, J. C. Jones in a recently published<sup>4</sup> study of Lake Lahontan, in Nevada, concludes that bones in a lake deposit which have been identified by Merriam as including a "camel" as well as the native horse and a Pleistocene "lion" can not be more than a thousand years old. In Arizona Bryan and Gidley<sup>5</sup> have discovered bones of the "camel," etc., seemingly associated with a dry lake whose shorelines are so fresh that they are unable to account for the presence there of a form which should date it to the early Pleistocene.

It thus seems that our present views of the succession of Pleistocene vertebrate faunas are much in need of revision. It is highly probable that, with the stumbling block of camelid antiquity removed, a more recent date may be assigned to some of our Pleistocene faunas, such as that of the Rancho La Brea.

This point has a bearing on another question—the antiquity of man on this continent. Whenever human artifacts are found with the remains of extinct animals the anthropologist springs to arms to repudiate the association. This point of view is not unreasonable in view of the usual implication that this connotes a considerable antiquity. As an illustration, the apparently certain association of stone implements and a fossil fauna in the Frederick (Okla.) gravel pit is attacked by Dr. Spear in a recent number of this journal<sup>6</sup> since the fauna (containing the "camel," etc.) is assigned by Dr. Hay to the first interglacial, while the artifacts are of a type which, even in Europe, are only present during or after the last glaciation. But may it not be true here (and presumably in other similar cases) that the true situation is not that man reaches to a remote antiquity in this continent, but that the camel and perhaps other Pleistocene forms have survived until a much later date than has been believed previously?

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<sup>4</sup> Carnegie Inst. Washington publ. 352, 1925, pp. 1-50.

<sup>5</sup> Amer. Jour. Sci., 5th ser. 11, 477-488, 1926.

<sup>6</sup> SCIENCE, n. s., XLVII, 1928, 160-161.